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RMRS Rocky Mountain Remediation Services, L.L.C.
. . . protecting the environment
Rocky Flats Environmental Technology Site
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Phone: (303) 966-7000

May 12, 1999

99-RF-01871

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Orig. & Typist Initials:

1/49

Alan D. Rodgers
Division Manager, Waste & Remediation Operations
Kaiser-Hill Company, L.L.C.
Building 130

SUBMITTAL OF DRAFT FINAL SAMPLING AND ANALYSIS PLAN FOR D&D GROUNDWATER MONITORING AT BUILDINGS 444, 771, AND 886 – MW-061-99

Enclosed please find eight copies of the FY99 Draft Final Sampling and Analysis Plan for D&D Groundwater Monitoring at Buildings 444, 771, and 886. This Sampling and Analysis Plan has been revised to incorporate Kaiser-Hill and DOE review comments received for the initial draft report originally submitted for joint Kaiser-Hill and DOE review. Please retain three copies of the report for Kaiser-Hill reference and transmit five copies to DOE. We recommend that DOE retain three copies for reference and transmit the two remaining copies to EPA and CDPHE for review and comment.

Field activities for these projects are currently scheduled to be initiated in June 1999. Please request that EPA and CDPHE return their comments by May 31, 1999, so that we can expedite comment resolution and start field activities at the earliest possible date.

Please contact me at extension 9878 with any questions.

Martin Wheeler

Martin Wheeler
Vice President, Waste Operations

JUN 1999
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RGS:slm:

Enclosure:
As Stated

cc:
G. H. Setlock

ADMIN RECORD
IA-A-000905

Date DRAFT

Joseph A. Legare
Assistant Manager, Environmental Compliance
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Building 460

SUBMITTAL OF DRAFT FINAL SAMPLING AND ANALYSIS PLAN FOR D&D GROUNDWATER MONITORING AT BUILDINGS 444, 771, AND 886 – DCS-xxx-99

This letter transmits five (5) copies of the FY99 Draft Final Sampling and Analysis Plan for D&D Groundwater Monitoring at Buildings 444, 771, and 886 for the Rocky Flats Environmental Technology Site. Previous Kaiser-Hill and DOE review comments have been incorporated into the report with concurrence received from the reviewers. Please submit one copy each to EPA and CDPHE for review and comment with a requested comment response date of May 31, 1999.

Please contact me at extension 4457 with any questions.

David C. Shelton
Title

DCS:xxx

Enclosures:
As Stated

cc:
N. I. Castaneda (DOE, Bldg. 460)
N. P. Cypher (RMRS, Bldg. T893A)
A. D. Rodgers (K-H, Bldg. 130)
G. H. Setlock (K-H, Bldg. T130C)
S. H. Singer (RMRS, Bldg. T893B)

RF/RMRS-99-313.UN

Sampling and Analysis Plan for the D&D Groundwater Monitoring of Buildings 444, 771, and 886

Draft Final

May 1999
Revision 0

3

SAMPLING AND ANALYSIS PLAN FOR THE D&D GROUNDWATER MONITORING OF BUILDINGS 444, 771, AND 886

RF/RMRS-99-313.UN

Revision: 0 (Draft Final)

May 11, 1999

This Sampling and Analysis Plan has been reviewed and approved by:

______________________________	____________
S. H. Singer, RMRS Project Manager	Date
______________________________	____________
G. D. DiGregorio, RMRS Quality Assurance	Date

Prepared by:
Rocky Mountain Remediation Services, L.L.C.
Rocky Flats Environmental Technology Site
Golden, Colorado

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ACRONYMS

ALARA	As Low As Reasonably Achievable
Am	Americium
APO	Analytical Project Office
AR	Administrative Records
ASD	Analytical Services Division
Be	Beryllium
CDPHE	Colorado Department of Public Health and the Environment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
D&D	Decontamination and Demolition
DER	Duplicate Error Ratio
DOE	U. S. Department of Energy
DQO	Data Quality Objective
EDD	Electronic Disc Deliverable
EMD	Environmental Management Department
EMSL	Environmental Monitoring Support Laboratory
EPA	U. S. Environmental Protection Agency
ER	Environmental Restoration
FID	Flame Ionization Detector
FIDLER	Field Instrument for the Detection of Low Energy Radiation
FO	Field Operations
GC/MS	Gas Chromatography/Mass Spectrometry
GPS	Global Positioning System
H_2SO_4	Sulfuric Acid
HCl	Hydrochloric Acid
HNO_3	Nitric Acid
HRR	Historical Release Report
IHSS	Individual Hazardous Substance Site
IA	Industrial Area
IM/IRA	Interim Measures/Interim Remedial Action
IMP	Integrated Monitoring Plan
K-H	Kaiser-Hill
LLW	Low-level waste
NaOH	Sodium Hydroxide
OPWL	Original Process Waste Line
OU	Operable Unit
PAC	Potential Area of Concern
PARCC	Precision, Accuracy, Representativeness, Completeness, and Comparability
PCB	Polychlorinated Biphenyl
PCE	Tetrachloroethene
PID	Photoionization detector
PPE	Personal protective equipment

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ACRONYMS (cont'd)

Pu	Plutonium
PVC	Polyvinyl chloride
QA/QC	Quality Assurance/Quality Control
QAPD	Quality Assurance Program Description
RCRA	Resource Conservation and Recovery Act
SWD	Soil and Water Database
RCRA	Resource Conservation and Recovery Act
RCT	Radiological Control Technician
RFCA	Rocky Flats Cleanup Agreement
RFETS	Rocky Flats Environmental Technology Site
RFI/RI	RCRA Facility Investigation/Remedial Investigation
RMRS	Rocky Mountain Remediation Services, L.L.C.
RPD	Relative Percent Difference
SAP	Sampling and Analysis Plan
SOPs	Standard Operating Procedures
TAL	Target Analyte List
TCE	Trichloroethene
TCL	Target Compound List
TPH	Total Petroleum Hydrocarbons
U	Uranium
VOC	Volatile Organic Compound

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LIST OF APPLICABLE STANDARD OPERATING PROCEDURES (SOPs)

Identification Number	Procedure Title
RF/RMRS-98-200	*Evaluation of Data for Usability in Final Reports*
2-S47-ER-ADM-05.15	*Use of Field Logbooks and Forms*
5-21000-OPS-FO.06	*Handling of Personal Protective Equipment*
5-21000-OPS-FO.07	*Handling of Decontamination Water and Wash Water*
4-K55-ENV-OPS-FO.10	*Receiving, Marking, and Labeling Environmental Materials Containers*
5-21000-OPS-FO.15	*Photoionization Detectors and Flame Ionization Detectors*
5-21000-OPS-FO.16	*Field Radiological Measurements*
4-S64-ER-OPS-GT.39	*Push Subsurface Soil Sampling (to be superseded by RMRS/OPS-PRO.124)*
RMRS/OPS-PRO.069	*Containing, Preserving, Handling and Shipping of Soil and Water Samples*
RMRS/OPS-PRO.070	*Decontamination of Heavy Equipment at Decontamination Facilities*
RMRS/OPS-PRO.072	*Field Data Management*
RMRS/OPS-PRO.101	*Logging Alluvial and Bedrock Material*
RMRS/OPS-PRO.102	*Borehole Clearing*
RMRS/OPS-PRO.105	*Water Level Measurements in Wells and Piezometers*
RMRS/OPS-PRO.106	*Well Development*
RMRS/OPS-PRO.108	*Measurement of Groundwater Field Parameters*
RMRS/OPS-PRO.113	*Groundwater Sampling*
RMRS/OPS-PRO.114	*Drilling and Sampling using Hollow-Stem Auger and Rotary Drilling and Rock Coring Techniques*
RMRS/OPS-PRO.117	*Plugging and Abandonment of Boreholes*
RMRS/OPS-PRO.118	*Monitoring Wells and Piezometer Installation*
RMRS/OPS-PRO.123	*Land Surveying*
RMRS/OPS-PRO.127	*Field Decontamination Operations,*
RMRS/OPS-PRO.128	*Handling of Purge and Development Water*
3-PRO-140RSP-09.03	*Radiological Characterization of Bulk or Volume Solid Materials*
RM-06.02	*Records Identification, Generation and Transmittal*
RM-06.04	*Administrative Record Document Identification and Transmittal*

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SAMPLING AND ANALYSIS PLAN FOR THE D&D GROUNDWATER MONITORING OF BUILDINGS 444, 771, AND 886

1.0 INTRODUCTION

1.1 Purpose

This sampling and analysis plan (SAP) provides for decontamination and demolition (D&D) groundwater monitoring of Building 444, Building 771, and Building 886 with respect to pre- and post-demolition hazardous and radiological site activities. These activities are designed to accomplish the objective of assessing the potential impact of building D&D activities on local groundwater quality. Building-specific D&D groundwater monitoring is required by the *Final Industrial Area (IA) Interim Measures/Interim Remedial Action (IM/IRA) Decision Document* (DOE 1994) with implementation accomplished under the *Integrated Monitoring Plan* (IMP) (DOE 1998). Implementation of this project will be performed in accordance with applicable Federal, State, and local regulations and agreements. Relevent U. S. Department of Energy (DOE) Orders, Rocky Flats Environmental Technology Site (RFETS) policies and procedures, and Environmental Restoration (ER) Operating Procedures also apply to this work.

The scope of the proposed program involves the installation and development of pre-D&D monitoring wells, establishment of pre-D&D groundwater quality baseline conditions, and semi-annual groundwater monitoring during the D&D process. Initial baseline groundwater sampling activities will be performed under this SAP followed by routine D&D groundwater monitoring as set forth in the IMP. Any changes to the groundwater monitoring program for these buildings, such as analyte lists or timing of sampling events, will be documented through this SAP until superseded by the IMP.

The objective of this SAP is to define specific data needs, sampling and analysis requirements, data handling procedures, and associated Quality Assurance/Quality Control (QA/QC) requirements for this project. All work will be performed in accordance with the RMRS Quality Assurance Program Description (QAPD) (RMRS, 1998a, Rev. 2).

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1.2 Background

1.2.1 Building 444

Building 444 is located on the south side of Cottonwood Avenue between Fourth and Sixth Streets at the Rocky Flats Environmental Technology Site. The expected scope of activities at the Building 444 cluster involves buildings 427, 445, 447, 448, 449, 450, 451, 453, 455, and 457.

The Building 444 cluster was used for the manufacturing of depleted uranium and beryllium components. Major processes conducted in the building include machining, welding, and cleaning. Building 444 also contains a foundry and a laboratory where parts could be etched, electroplated, and coated. Uranium and beryllium are the major constituents that were used in the building. In addition, solvents from machining and cleaning, and other wastes associated with electroplating were generated. Building 444 did not handle plutonium or enriched uranium. Figure 1-1 presents a site location map of Building 444 and the surrounding area.

The following process wastes have been generated by activities conducted in Building 444:

- **Acids:** nitric acid (HNO_3), phosphoric acid (H_3PO_4), and sulfuric acid (H_2SO_4), also plating acids with concentrated chromium plating solution;
- **Bases:** chromium trioxide;
- **Solvents:** acetone, alcohols, tetrachloroethylene (PCE), 1,1,1-trichloroethane (1,1,1-TCA);
- **Radionuclides:** uranium (U), and tritium (H-3);
- **Metals:** beryllium (Be), cadmium, chromium, lead, silver; and
- **Others:** cyanide, arsenic, oil (vacuum pump, compressor, machining coolant, hydraulic fluid).

Nine associated Potential Areas of Concern (PACs), 400-116.1, 400-116.2, 400-136.1, 400-136.2, 400-157.2, 400-182, 400-207, 400-208, and 400-810, are listed in the RFETS *Historical Release Report* (HRR) (DOE 1992a). The PACs were established as the result of documented spill incidents. Only PACs that are pertinent to this investigation, which means that they are located in Building 444 or associated adjacent buildings, will be discussed in this section.

400-116.1, West Loading Dock-Building 444

The west loading dock is loaded on the north side of Building 447 and is west of Building 444. According to DOE (1992a), there is a possibility that solvents were stored at this site as well as at the south loading dock. Building 453, located in the alcove formed by Buildings 447 and 444, was known to have stored oil. Spills and leaks may have impacted soil and groundwater beneath the dock. Due to the nature of operations in Buildings 447 and 444, radioactive materials may also contaminated soils in this area. Areas south of Building 447, west of Building 444, and north of Building 453 were identified as areas which could not be radiometrically surveyed (1977 to 1984 site-wide survey) due to high-level background radioactivity (DOE, 1992a).

400-116.2, South Loading Dock-Building 444

Located on the south side of Building 444 and east of Building 447, the south loading dock has experienced many incidents that may have contributed to contamination in this area. In 1953, high winds blew the lids off drums stored there releasing uranium to the dock, sidewalks, and driveways. On August 30, 1954, the motor of a portable vacuum short-circuited while it was being used in a centrifuge. The vacuum bag contents ignited and were transferred to a steel drum at the dock. The explosive nature of the burning material released large amounts of airborne contamination to the outside atmosphere and covered the dock and adjacent area with oxide. In October 1955, a 55-gallon drum of perclene still bottoms and nitric acid stored on the dock leaked and sprayed its contents onto two workers who were nearby. Until 1970, chlorinated hydrocarbon solvents used to rinse beryllium parts were dumped onto the ground outside Room 106 which opens to the loading dock. Constituents that may have contaminated the soil around the south dock include, but may not be limited to, enriched and depleted uranium, beryllium, and chlorinated solvents. No documentation was found that details the quantities or fate of constituents released to the environment.

400-157.2, Radioactive Site South Area

Several operations associated with Building 444 have contributed to contamination in the area. This area encompasses other PACs, including 400-166.1, 400-116.2, 400-136, and 400-810, which are described separately in this section.

In March 1954, soil sampling revealed contamination twice to three times background in a ditch south of Building 444 caused by washing the dock and apron. Storage in an open ingot storage area east of Building 444, a metal storage area to the south of the building, and a uranium machine tool storage area to the west undoubtedly resulted in low level contamination of the soil. Documented incidents in the HRR (DOE, 1992a) are described as follows.

In May 1960, a vacuum collector fire in Building 447 resulted in the release of approximately 44 microCuries of depleted uranium. The depleted uranium was deposited on the roof of the building. In December 1962, a uranium and beryllium release from Building 444 occurred through an unfiltered hood. In June 1966, a process waste line broke north of Building 444. On November 11, 1974, 170 square feet of road south of Building 444 (probably Cedar Avenue) was contaminated when a barrel containing uranium chips was dropped during transfer. An incident on November 4, 1985, involved pressurization of a process line in Building 447. The pressure forced liquid through the floor drain and up the vent pipe onto the roof where it ran into the gutter and onto the ground. Contamination levels were as high as 10,000 cpm beta activity. Another incident occurred while tranferring three drums across pland site on November, 30, 1990. One barrel containing beryllium ingots was found to have somehow picked up radionuclide contamination. An area of high smear counts (greater than 25 cpm/ft^2) was found just outside the beryllium machine shop (Building 444) at the exit/entrance door. No documentation was found that detailed the fate of contaminants released to the environment (DOE, 1992a).

<u>400-182, Building 444/453 Drum Storage Area</u>

In May 1957, it was observed that numerous barrels of depleted uranium oxide were being stored on the ground in the back (west side, adjacent to Building 453) of Building 444. There was concern that the barrels would be subject to corrosion. For many years, Building 453 (an approximately 2,500 square foot building located immediately adjacent to the west central inverted corner of Building 444) was used as an oil storage area. Periodically, high groundwater has forced oil to pool adjacent to the building. Aerial photographs taken in 1982 revealed heavy, dark staining around Building 453 and along the west side of Building 444. Constituents that may have contaminated soil in the Building 444/453 drum storage area are depleted uranium oxide waste and oil. No documentation was found which detailed what the oil was used for or if it was contaminated. No documentation was found that details the quantities or fate of constituents released to the environment.

<u>400-810, Beryllium Fire - Building 444</u>

On February 23, 1978, a welder working on a small inlet duct of the beryllium air plenum that serves Building 444 noticed a fire on the face of the pre-filters. The exhaust fan automatically shut down and the resulting negative pressure inside the building caused smoke to back up into Room 107. Analytical results indicated that 14.5 grams of beryllium had been released. This constituted an EPA standard violation. Employees were monitored and measures were taken to clean up the area. All subsequent monitoring of the area showed background levels of beryllium.

In 1990, a fire in Room 345 caused extensive damage and shut down the production-plating laboratory. Room 245, the Research and Development plating laboratory, contained numerous process lines and tanks for storage of chemicals. The current contamination status of Building 444 has not been thoroughly assessed and some contamination is likely to be present.

The southeast portion of Building 444 and the western half of Building 447 have foundation drains. The drains are located at elevations that are not more than five feet below the static elevation of the water table. When the buildings are demolished, the water table will equilibrate inside the bottom of the building basements (assuming that the drains are decommissioned) or area once occupied by the basements, which could potentially mobilize contaminants from flooded basements and/or foundations into the surrounding groundwater regime.

1.2.2 Building 771 (Including 771C and 774)

Building 771 is located in the Protected Area (PA), at the northeast end of the diagonal road, immediately south of the PACS-3 entrance to the PA. The expected scope of activities for Building 771 also involves the D&D of Buildings 771, 771C, and 774. These three buildings are connected as described in the following paragraph.

From 1953-1957, Building 771 was the plutonium components production facility at Rocky Flats. After 1957 the building was used for the chemical recovery of plutonium and americium from manufacturing residues and scrap metal. The building also contained a laundry. Plutonium and americium are the major radiological constituents that were used in the building. In addition, solvents from machining operations were common. Building 774 is located approximately 200 feet due east of Building 771. Building 771C connects the two buildings. Buildings 771C and 774 are to be decommissioned along with Building 771. Building 774 was used for the treatment of radioactive aqueous waste, waste oils, and non-radioactive photograph solutions. Plutonium and americium are the major radiological constituents that were used in the building. Figure 1-2 presents a site location map of Building 771. The Building 771 area, including Buildings 771C and 774, includes IHSSs 143, 150.1, 150.2, and 150.3.

Building 771 has historically contained mixed low-level radioactive and hazardous waste, mixed transuranic and hazardous waste, as well as non-radioactive hazardous waste. The following process wastes have been generated by activities conducted in Buildings 771, 771C, and 774:

- **Acids:** nitric acid, sulfuric acid, hydrochloric acid (HCl), and potentially hydrofluoric acid;
- **Bases:** sodium hydroxide (NaOH), potassium hydroxide (KOH), and hydrogen peroxide (H_2O_2);
- **Solvents:** denatured alcohol, trichloroethylene (TCE), and carbon tetrachloride;
- **Radionuclides:** plutonium, americium, neptunium and;
- **Others:** polychlorinated biphenyls (PCBs), and nickel carbonyl.

Seven associated PACs, 700-143, 700-146, 700-150.1, 700-150.2, 700-150.3, 700-1108, and 700-1110 are listed in the RFETS HRR (DOE 1992a). The PACs were established as a result of documented spill incidents. Only PACs that are pertinent to this investigation, which means that they are located in Buildings 771-771C-774 or immediately adjacent to the buildings, are discussed in this section.

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700-146, Concrete Process Waste Tanks

Six underground process waste tanks were located south of the original Building 774. Building 774 has been modified several times since its construction in 1952. During the construction of a south addition in 1972, the six tanks were removed. These tanks, at the present location of the south wing of Building 774, were known to have leaked and overflowed. It is suspected that leakage from these tanks seeped to the building foundation drain. The process waste stored in the tanks was an aqueous solution containing plutonium, uranium, acids, and caustics.

700-150.3, Radioactive Site Between Buildings 771 and 774

In August 1971, during excavation for construction between Building 771 and Building 774, a cement tunnel containing process waste lines was exposed. Cracks in the concrete walls were found to be contaminated. In September 1971, subsequent construction excavation resulted again in the exposure of the tunnel between Buildings 771 and 774. In December 1971 or January 1972, construction activities in this area resulted in a broken process waste line. In the early 1980s, a flange in a line separated releasing an unspecified amount of aqueous process waste. The constituents that may have contaminated the area between Buildings 771 and 774 include, but may not be limited to, radionuclides and nitrates. No documentation was found which details the quantities or fate of the constituents released.

Foundation drains are present in Buildings 771 and 774. The drains are located at elevations that are as much as 12 feet below the existing water table. When the buildings are demolished, the water table will equilibrate inside the bottom of the building basements (assuming that the drains are decommissioned) or are once occupied by the basements, which could potentially mobilize contaminants from within flooded basements and/or foundations into the surrounding groundwater regime.

1.2.3 Building 886

Building 886 is located on the south side of Central Avenue at RFETS, approximately 300 feet southeast of the PACS-1 entrance to the PA. The expected scope of activities for the Building 886

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cluster also involves the D&D of four (4) associated buildings: 875, 880, T886A, and 888A. In addition, there is a tunnel which connects Buildings 886 and 875. The tunnel will be grouted in place as part of the D&D.

Building 886, first occupied in 1965, houses the Critical Mass Laboratory which was used for conducting criticality experiments for nuclear safety research and development. The building also houses offices and a small electronics/machine shop. The building and surrounding area, including Building T886A, Building 828 and the eastern half of Building 888A, comprise IHSS 164.2, an area affected by historical releases of uranium resulting from spills and the movement of contaminated equipment. Historical information about this IHSS was derived from interviews with building personnel (DOE 1992b). Figure 1-3 presents a site location map of Building 886 and associated buildings.

The following process wastes have been generated by activities conducted in Building 886:

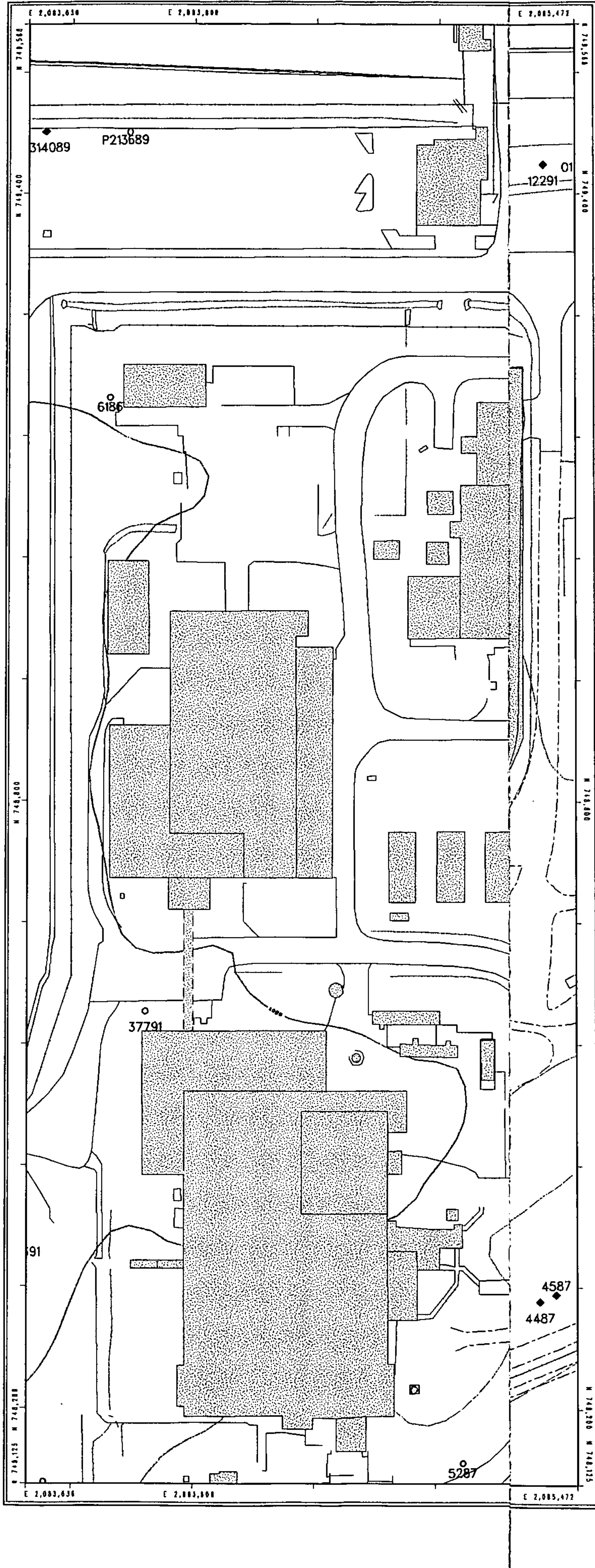
- **Radionuclides:** plutonium, uranium and;
- **Others:** nitrates

Two associated PACs, 800-164.2 and 800-1203, are listed in the RFETS HRR (DOE 1992a). The PACs were established as the result of documented spill incidents. Only PACs that are pertinent to this investigation, which means that they are located in Building 886 or immediately adjacent to the building, are discussed in this section.

Enriched uranium solutions, solid enriched uranium, and plutonium metal have been used in Building 886 (DOE, 1992b). To the west of the building, a 1,000-liter low-level waste holding tank located in a below grade, covered, underground concrete pit has been implicated as a potential source of groundwater contamination. Uranium contamination is present in the pit and groundwater has historically accumulated in the area, thus indicating a potential for localized contaminant releases to groundwater. Activities associated with the removal of waste solution from the pit may have resulted in spills onto the dirt or concrete (DOE, 1992b).

Figure 1-3

Building 886 Site Location
Existing and Proposed Monitoring Wells



EXPLANATION

- ○ Program Wells
- ● All Other Wells (Abandoned Wells Not Included)
- △ Location of Proposed Monitoring Wells

Industrial Area Operable Units

- Pertinent B886 IHSSs

Standard Map Features

- Buildings and other structures
- Solar evaporation ponds
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Contour (20-Foot)
- Paved roads
- Dirt roads

DATA SOURCE:
Buildings, fences, hydrography, roads and other structures from 1994 aerial fly-over data captured by EG&G RSL, Las Vegas. Digitized from the orthophotographs. 1/95
Topology (contours) were derived from digital elevation model (DEM) data by Morrison Knudsen (MK) using ESRI Arc TIN and LATTICE to process the DEM data to create 5-foot contours. The DEM data was captured by the Remote Sensing Lab, Las Vegas, NV, 1994 Aerial Flyover at ~ 10 meter resolution. DEM post-processing performed by MK, Winter 1997.

Scale = 1 : 1790
1 inch represents approximately 149 feet

50 0 100 200ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Prepared by:
RMRS Rocky Mountain Remediation Services, L.L.C.
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P.O. Box 464
Golden, CO 80402-0464

MAP ID: 99-0163 April 22, 1999

NT_Svr w:/projects/fy99/99-0163/map1-3/dd-sap-886.aml

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<u>800-164.2, Radioactive Site 800 Area Site No. 2 Building 886 Spills</u>

Since the occupancy of Building 886 in 1965, the area has been a source of concern for possible soil contamination. It is well documented that soil under and around the building is contaminated from uranium spills. A contamination release was documented on June 9, 1969. Another incident occurred on September 26, 1989, when a colorless liquid was found slowly dripping onto the concrete pad through the drain valve of an empty 500-gallon stainless steel transfer tank located outside the west side of the building. The release created a wet spot on the concrete approximately 5 inches in diameter. Radiological monitoring of the area after the discovery indicated 650 counts per minute (cpm) from a direct survey and 12 to 24 disintegrations per minute (dpm) from a removable contamination survey. The radiological analyses indicated the level of contamination was low. Analyses of soil samples taken around the tank after the survey identified the contaminant as uranium. Removal and cleanup activities were performed and no residual contamination remained (DOE, 1992b).

Potential for contamination also occurred outside the west side of the building, before 1969, at the location of a filter plenum. Filter changes and clean-out operations were always a potential release source of uranium to the environment (DOE, 1992b). Another potential source of radionuclide contamination is experimental equipment stored south of the building and IHSS 164.2 boundary in a storage shed (Building 880). Some of the equipment stored in this area is known to be contaminated by radionuclides. The area over which the equipment was transported between buildings has the potential for exposure to this type of radiological contamination (DOE, 1992b). Additionally, within the Building 886 experimental areas, contaminated solutions have periodically been spilled on the floor. A potential exists for solution leakage through cracks in the concrete slab (DOE, 1992b).

A foundation drain is present in Building 886 along the west side of the building. The drain is located at elevations which are as much as five to ten feet below the elevation of the existing water table, depending on location. When the building is demolished, and the drain system is no longer operable, the water table will equilibrate inside the bottom of the building basements (assuming that the drains are decommissioned) or are once occupied by the basements, which could potentially mobilize contaminants from within flooded basements and/or foundations into the surrounding groundwater regime.

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1.3 Hydrogeologic Setting

Buildings 444, 771, and 886 are situated on a gently eastward sloping topographic and bedrock pediment surface mantled by, depending on location, unconsolidated Rocky Flats Alluvium and/or colluvium, and underlain mainly by claystones and siltstones of the Cretaceous Laramie Formation (EG&G, 1995a). Buildings 444 and 886 are situated in Rocky Flats Alluvium, whereas Building 771 is situated predominantly in colluvium.

1.3.1 Building 444

The thickness of the alluvium at Building 444 ranges from about 22 feet at well P419689, located approximately 100 feet southeast of the building, to about 23 feet at well P218289, located approximately 150 feet northeast of the building. The depth to groundwater (2nd quarter 1997 data) ranged from 7 feet at P218289 to about 17 feet at P419689 resulting in an alluvial saturated thickness of approximately 5 to 16 feet. Historical water level fluctuations, derived from well hydrographs, have been as much as 3.5 feet for each of wells P218289 and P419689. The closest currently active and potentially upgradient wells to Building 444 are wells 4486 and P416289, located approximately 400 feet to the northwest and approximately 600 feet to the west, respectively. These wells are not suitable for sampling as upgradient wells because they are not located between Building 444 and the adjacent upgradient buildings. Well P419689 is the closest downgradient well. Figure 1-1 illustrates the location of existing monitoring wells found in the Building 444 area.

Analysis of groundwater flow patterns in the vicinity of Building 444 is complicated by a lack of sufficient well control near the building and the divergent nature of the flow field in this area of the Site. According to previous interpretations (RMRS, 1998b, Plate 2), groundwater at Building 444 is expected to flow predominantly in an east/southeast direction with a horizontal hydraulic gradient of about 0.008 ft/ft in the vicinity of the building, and a hydraulic gradient of about 0.140 ft/ft further to the southeast. Figure 1-4 illustrates the potentiometric contours from 2nd quarter 1997 data (RMRS 1998b, Plate 2). A broad, east-west trending, ridge-like pattern dominates the flow field in this region of the Industrial Area (IA), which creates a poorly defined groundwater divide just to the north of Building 444. This divide appears to exist mainly as a result of natural topographic and geologic controls, but may be influenced by anthropogenic features such as the Building 400 complex. The potentiometric map referenced above accounts for potential flow perturbations caused by building foundation drains.

The presence of subsurface barriers or sinks, such as building basements, foundation drains, deep storm drains, excavations, and buried utility corridors can locally alter groundwater flow directions and lead to containment or spreading of contaminant plumes. Buildings 444 and 447 were constructed with foundation drains which, in general, have a small footprint and do not greatly influence potentiometric contours. There is also a deep storm drain from Building 447 which flows south and may have a significant influence on flow to the south of Building 444. Building 460, located immediately to the west of Buildings 447 and 444, may influence groundwater flow because it was constructed 4 to 5 feet below grade and relies on a buried storm sewer system for drainage. The western storm sewer line extends the entire length of the building in a north-south direction at an estimated depth of 4 to 5 feet. Evidence of groundwater discharge to this line was observed on May 12, 1998, at two inlet grates located at the north and south ends of the western Building 460 sewer line. At the northern inlet grate, groundwater seepage was observed entering the concrete inlet structure along a seam at a depth of about 2 feet. A continuous trickle of water was observed issuing from the pipe at the southern inlet grate before joining with the east line and discharging to the Woman Creek drainage. Additional groundwater discharge is assumed to occur through permeable bedding material that typically encloses underground lines. A natural seepage area located due south of Building 664 also contributes to the drainage of the 400-complex area.

The effect of these artificial features on the water table is expected to be greatest during spring when water levels reach seasonal highs and interact more extensively with the subsurface drainage structures.

Depression of the potentiometric configuration at the 400-complex is expected to result in a more southeastward groundwater flow direction at Building 444. These structures are assumed to affect shallow groundwater flow only during brief, high water level periods associated with a spring recharge event, but in actuality, the Building 447 storm drain flows year round suggesting a perennial effect.

Based on flow path analysis of potentiometric data, the nearest receiving stream for groundwater originating at Building 444 is Woman Creek, located approximately 1200 feet to the south. For approximately 600 feet southeast of the building, groundwater flows through the Rocky Flats Alluvium, then through colluvium to Woman Creek. The groundwater flow velocities for conservative (non-reactive) constituents are estimated at 17.4 ft/yr and 135.2 ft/yr, assuming geometric mean hydraulic conductivities for the Rocky Flats Alluvium of 2.1×10^{-4} cm/sec and colluvium of 9.33×10^{-5} cm/sec (EG&G, 1995b, Table G-2), respectively, an effective porosity of 0.1 (Hurr, 1976), and the hydraulic gradient values given above. This velocity translates to a minimum contaminant travel time from Building 444 to surface water of about 39 years. Actual contaminant travel times can be expected to be much longer for highly retarded contaminants such as plutonium and americium, and slightly longer for weakly retarded contaminants, such as VOCs and some metals.

The existing groundwater quality beneath Building 444 and along the flow path towards Woman Creek is mainly impacted by VOCs. The southern end of the IA VOC plume, where the VOC concentrations are equal to or greater than the MCL, encompasses the flow path through the Rocky Flats Alluvium and into the colluvium towards Woman Creek. Nitrates and radiological contamination does not appear to be significant along the groundwater flow path from Building 444 to Woman Creek (RMRS, 1998b).

1.3.2 Building 771

Building 771 is excavated into bedrock. The thickness of colluvium adjacent to the Building 771 complex ranges from about 11 feet at well P219189, located approximately 150 feet northeast of the building, to about 18 feet at well 22696, located approximately 150 feet southwest of the building. The depth to groundwater (2nd quarter 1997 data) ranged from dry at 22696 to about 10.6 feet at P219189 resulting in a saturated thickness of 0 to 0.4 feet. Historical water level fluctuations, derived from well hydrographs, have been as much as six feet in well 22696 and 3.5 feet in well P219189. The closest currently active, upgradient, wells to Building 771 are the cluster of wells (associated with IHSS 118.1) located approximately 125 feet to the south. Well 22796, located approximately 100 feet north of the building, is the closest downgradient well. Figure 1-2 illustrates the location of existing monitoring wells found in the Building 771 area.

Analysis of groundwater flow patterns in the vicinity of Building 771 is complicated by a lack of sufficient well control near the building. According to previous interpretations (RMRS, 1998b, Plate 2), groundwater at Building 771 is expected to flow predominantly in a northerly direction with a horizontal hydraulic gradient of about 0.050 ft/ft, assuming isotropic conditions. Figure 1-4 illustrates the potentiometric contours from 2nd quarter 1997 data (RMRS 1998b, Plate 2). This map accounts for potential flow perturbations caused by building foundation drains.

Buildings 771 and 774 were constructed with foundation drains. In general, the foundation drains for Buildings 771 and 774 influence local potentiometric contours in the immediate area of the buildings, but not at a distance. The closest foundation drain to the Building 771 area (that is not associated with Building 771) begins at the northwest corner of Building 779 and continues along the north side of the building. The drain then angles northeast and continues north between the western and central Solar Evaporation Ponds. This structure is approximately 350 feet from Building 771. It appears to have no significant influence on potentiometric contours along its length.

The effect, if any, of these artificial features on the water table is expected to be greatest during spring when water levels reach seasonal highs and potentially could interact with the subsurface drainage structures. Depression of the potentiometric contours in the Building 771 area is expected to result in a flatter hydraulic gradient beneath Buildings 771 and 774.

Based on flow path analysis of potentiometric data, the nearest receiving stream for groundwater originating at Building 771 is North Walnut Creek, located approximately 550 feet to the north. The groundwater flow velocity for conservative (non-reactive) constituents is estimated at 48.3 ft/yr, assuming a geometric mean hydraulic conductivity for colluvium of 9.33×10^{-5} cm/sec (EG&G, 1995b, Table G-2), an effective porosity of 0.1 (Hurr, 1976), and the hydraulic gradient value given above. This velocity translates to a minimum contaminant travel time from Building 771 to surface water of about 11 years. Actual contaminant travel times can be expected to be much longer for highly retarded contaminants and slightly longer for weakly retarded contaminants.

The existing groundwater quality beneath Building 771 and along the flow path towards North Walnut

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Creek is mainly impacted by VOCs. The northern edge of the IA VOC plume, where the VOC concentrations are equal to or greater than the MCL, extends more than 100 feet north of the building through monitoring well 22796. The 100x the MCL VOC plume associated with IHSS 118.1 (carbon tetrachloride plume) lies immediately south of the building and may actually encroach beneath the building from the south. Building 771 foundation drain samples have shown carbon tetrachloride contamination. No other IA contaminant plumes are located within the Building 771-771C-774 complex. Monitoring well P219189, located approximately 100 feet north of Building 771C, exhibited readings for tritium during two quarters of 1997 that were approximately an order of magnitude higher than background (RMRS, 1998b). Because of this occurrence, tritium will be sampled for, at least initially, in D&D monitoring wells associated with Building 771.

1.3.3 Building 886

The thickness of alluvium at Building 886 ranges from about 6.4 feet at well P317989, located approximately 180 feet southwest of the building, to about 9 feet at well 22996, located approximately 100 feet east of the northeast corner of the building. The depth to groundwater (2nd quarter 1997 data) ranged from 3.5 feet at well P317989 to 6.15 feet at well 22996 resulting in an alluvial saturated thickness of 2.9 feet. Historical water level fluctuations, derived from well hydrographs, have been as much as 9 feet in well 22996 and 6 feet in well P317989. The closest currently active and potentially upgradient well to Building 886 is well P317989 which is located approximately 180 feet southwest of the building. Well 22996 is the closest, potentially downgradient, well to Building 886. It is located approximately 80 feet east of the northeast corner of the building. Both of these wells can be utilized for D&D monitoring with respect to water levels and chemical analyses. Figure 1-3 illustrates the location of existing monitoring wells found in the Building 886 area.

Analysis of groundwater flow patterns in the vicinity of Building 886 is complicated by a lack of sufficient well control near the building and the divergent nature of the flow field in this area of RFETS. According to previous interpretations (RMRS, 1998b, Plate 2), groundwater at Building 886 is expected to flow predominantly in a northeast direction with an average horizontal hydraulic gradient of 0.042 ft/ft in the Rocky Flats Alluvium northeast of the building, and a hydraulic gradient of 0.090 ft/ft in the colluvium further to the northeast. Figure 1-4 illustrates the potentiometric contours from 2nd quarter 1997 data (RMRS 1998b, Plate 2). A broad, east-west trending, ridge-like pattern

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dominates the flow field in this portion of the IA. This ridge creates a poorly defined groundwater divide to the south of Building 886. This divide appears to exist mainly as a result of natural topographic and geologic controls, but may be influenced somewhat by anthropogenic features.

Building 886 was constructed with a foundation drain along the west side of the building. Figure 1-4 accounts for potential flow perturbations caused by building foundation drains. In the immediate area of Building 886 the foundation drain appears to have a locally significant influence on the elevation 5980 potentiometric contour. Building 865, located immediately west of Building 886, has a fairly extensive foundation drain that does not appear to significantly impact the local alluvial water table. Utility corridors may be especially important at Building 886 because of the occurrence of shallow bedrock and thin alluvial saturated thickness.

The effect of these artificial features on shallow groundwater flow is expected to be greatest during spring when water levels reach seasonal highs and interact even more extensively with the subsurface drainage structures. Depression of the elevation 5980 potentiometric contour during high water table in the Building 886 area is anticipated to have a moderate effect on the alluvial water table.

Based on flow path analysis of potentiometric data and the discussion above, the nearest receiving stream for groundwater originating at Building 886 is South Walnut Creek, approximately 900 feet along the presumed groundwater flow direction to the northeast. For approximately 700 feet, from Building 886 northeast towards South Walnut Creek, groundwater flows through the Rocky Flats Alluvium, then through colluvium the remaining 200 feet to South Walnut Creek. The groundwater flow velocities to South Walnut Creek for conservative (non-reactive) constituents are estimated at 91.3 ft/yr and 86.9 ft/yr, assuming geometric mean hydraulic conductivities for the Rocky Flats Alluvium of 2.1×10^{-4} cm/sec and colluvium of 9.33×10^{-5} cm/sec (EG&G, 1995b, Table G-2), respectively, an effective porosity of 0.1 (Hurr, 1976), and the hydraulic gradient values listed above. This velocity translates to a minimum contaminant travel time from Building 886 to South Walnut Creek of 10 years. The existing groundwater quality beneath Building 886 appears to be unaffected by any of the existing IA contaminant plumes (RMRS, 1998b). This observation may be partially due to the lack of well coverage in the area surrounding Building 886.

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2.0 SAMPLING RATIONALE

Historical information detailed in Section 1.2 provides general indications of the types of compounds anticipated at each building area, and was used to develop a systematic sampling strategy for these investigations. The sampling rationale also accounts for the presumed direction of groundwater flow evaluated for each building area in Section 1.3 and the need for establishing background (upgradient) groundwater quality benchmarks for selected contaminants-of-concern. Monitoring well locations have been selected along groundwater flow paths associated with contaminant release areas for each building. Groundwater sampling will generally be restricted to new monitoring wells installed at Buildings 444, 771, and 886; however, water level measurements, and occasional samples (as described in Section 4.1), from additional wells in the vicinity of the individual areas will be collected to strengthen groundwater flow and quality interpretations. Additional wells for water level measurements are listed in Section 4.5.

The following conditions were considered in the development of the sampling strategy:

- The operating history of Building 444 indicates that volatile organic, uranium isotopes and tritium, cyanide, nitrate, petroleum, and numerous metal contaminants could be released to the environment from surface and subsurface sources during D&D;

- The operating history of Building 771 indicates that volatile organic, plutonium and americium, neptunium, PCBs, and nitrate contaminants could be released to the environment from surface and subsurface sources during D&D;

- The operating history of Building 886 indicates that uranium isotopes, plutonium, and nitrate contaminants could be released to the environment from surface and subsurface sources during D&D;

- The physical and chemical properties of these contaminants suggest a chronic presence if released into the environment;

- Historical data indicate the presence of contaminants in quantities above the maximum background concentrations defined by Site Procedure 3-PRO-140-RSP-09.03, *Radiological Characterization of Bulk or Volume Solid Materials* and the *Background Geochemical*

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Characterization Report (DOE 1993); and

- Subsurface Industrial Area structures and operations may cause local effects on groundwater flow direction and discharge that affect monitoring system design.

The conceptual model of contaminant migration to groundwater involves percolation of liquids and leaching of contaminants from surface soils and foundations and drains downward through the unsaturated zone to the water table, and leaching of contaminants from subsurface waste lines during high water table periods. After contaminants encounter the saturated zone, contaminant migration could proceed laterally and follow the principal direction of groundwater flow. Groundwater at Building 444 is presumed to flow in an easterly to southeasterly direction. Groundwater at Building 771 is presumed to flow in a northward direction. Groundwater at Building 886 is presumed to flow in a northeasterly direction. Contaminant movement in the unsaturated and saturated zones may be retarded to various degrees by sorption, volatilization, or biodegradation, depending on the chemical behavior of the contaminant. Contaminant concentrations may also be reduced by dispersion during migration.

Paved portions of the Building 444 area, which encircle much of the building out to the surrounding streets, are expected to significantly impede infiltration and associated contaminant migration from the surface, as most precipitation and surface runoff is diverted to the storm water drainage system instead of percolating through the ground surface. Buildings 771 and 886 have a much lower percentage of unpaved areas immediately adjacent to the buildings, thus increasing the potential for infiltration and contaminant movement through surface soils in these areas.

3.0 DATA QUALITY OBJECTIVES

The data quality objective (DQO) process consists of seven steps and is designed to be iterative; the outputs of one step may influence prior steps and cause them to be refined. Each of the seven steps are described below for the investigative areas presented in Figures 1-1, 1-2, and 1-3. Data requirements to support these investigations were developed and are implemented in the project using criteria established in *Guidance for the Data Quality Objective Process*, QA/G-4 (EPA 1994).

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3.1 State the Problem

Previous investigations of the individual Sites have identified various types of contamination that have either been released to soils or leaked from various subsurface process lines and/or sumps. The purpose of these investigations is to establish baseline groundwater quality conditions at each building prior to D&D activities, and to determine the presence or absence of potential hazardous and/or radioactive contamination located in groundwater downgradient of the buildings resulting from D&D activities.

3.2 Identify the Decision

Decisions required to be made using data collected from groundwater wells and samples include:

- Do contaminants of concern from the Buildings have the potential to impact groundwater?
- Does D&D activity create an adverse impact to groundwater which can affect surface water quality? If yes, as per the IMP, are concentrations above the mean +2 standard deviations with respect to ambient (baseline) concentrations?
- Do water table elevations and resulting groundwater flow path interpretations reinforce the groundwater quality results?

3.3 Identify Inputs to the Decision

Inputs to the decision include radiochemical and chemical results from groundwater samples collected from existing and newly-installed monitoring wells utilized to establish a pre-D&D baseline. The parameters of interest include the analyses outlined in Table 4-4, *Analytical Requirements for Groundwater Samples.*

Further inputs to the decision include water level measurements from new and existing monitoring wells, which will be used to delineate groundwater flow directions for interpretation of groundwater analytical data. Land surveying of new well casing locations (± 1 foot) and elevations (± 0.01 foot) will be conducted as per RMRS/OPS-PRO.123, *Land Surveying,* to provide control for potentiometric contouring.

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3.4 Define the Boundaries

The investigative boundaries and rationale are detailed in Section 4 of this SAP.

3.5 Decision Rule

If the radiochemical activities or chemical concentrations in the groundwater exceed the established baseline during or after D&D, an evaluation of potential impacts to surface water is required as well as notification of the appropriate parties as per the IMP decision tree for building-specific D&D monitoring wells

3.6 Limits on Decision Errors

Additional characterization, if required, will be based upon an evaluation of data collected under this SAP. An evaluation of an exceedance to the established baseline can be performed by laboratory data evaluation utilizing PARCC parameters and data validation. Data validation typically is performed on 25 percent of the laboratory analytical data. Well locations, as shown on Figures 1-1, 1-2, and 1-3, are based on previous hydrogeologic investigations, current-day field observations, interpretation of groundwater flow directions, and the location of contaminant releases and OPWLs and RCRA process lines. Groundwater monitoring will be performed in accordance with this SAP and the RFETS Integrated Monitoring Plan (DOE 1997).

3.7 Optimize the Design

In the event that further characterization is required to evaluate contaminant releases to groundwater from Buildings 444, 771, or 886, the results of the investigations described in this SAP will be used design additional field activities, such as selection of additional well locations and refinement of the analytical parameter suite. Additional phases of field activity will be implemented under a separate SAP or the IMP.

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4.0 SAMPLING ACTIVITIES AND METHODOLOGY

4.1 Monitoring Well Locations and Numbering

4.1.1 Building 444

Five (5) new monitoring well locations have been chosen to monitor groundwater quality associated with Building 444. Two (2) wells will be positioned north and west of the building to monitor upgradient groundwater quality, and three (3) wells will be positioned south and east of the building to monitor downgradient groundwater quality. Figure 1-1 illustrates the location of these wells with relationship to Building 444 and surrounding features. The total number and arrangement of wells reflects the spatial complexity of potential contaminant releases at the building and uncertainty regarding the configuration of the local groundwater flow field. Individual well locations were determined with respect to potential contaminant source areas (as reviewed in the HRR), and an assumed east to southeast groundwater flow direction. Well names (location codes) were assigned based on a five digit numbering system adopted by ER in 1992, with the year drilled indicated by the last two digits. The rationale for each new monitoring well location is summarized in Table 4-1.

Table 4-1 Building 444 Monitoring Well Location Rationale

Well Number	Location	Rationale
40099	West side Building 444, 130 feet South of NW corner of building	Monitor upgradient groundwater quality
40199	North side Building 444, 170 feet East of NW corner of building	Monitor upgradient groundwater quality
40299	South side Building 447, 40 feet West of SE corner of building	Monitor downgradient groundwater quality
40399	East side Building 444, 170 feet south of NE corner of building	Monitor downgradient groundwater quality
40499	SE corner Building 444	Monitor downgradient groundwater quality, specifically south loading dock and 444/453 drum storage area

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4.1.2 Building 771

Four (4) new monitoring well locations have been chosen to monitor groundwater quality associated with Building 771 and associated buildings 771C and 774. One (1) well will be positioned south of Building 774 to monitor upgradient groundwater quality, and three (3) wells will be positioned north of Building 771-771C to monitor downgradient groundwater quality. Existing monitoring well P219089 will be used to monitor water quality downgradient of Building 774, specifically downgradient of the six process waste tanks previously located beneath the south wing of Building 774. In addition, because of building and utilities location constraints, one or more new monitoring wells installed as part of the IHSS 118.1 groundwater study (January-February 1999) will be utilized as an upgradient well(s). Figure 1-2 illustrates the location of these wells (minus new IHSS 118.1 wells) with relationship to Building 771 and surrounding features. The total number and arrangement of wells reflects the spatial distribution of potential contaminant releases at the building and uncertainty regarding unsaturated areas in the vicinity. Individual well locations were determined with respect to potential contaminant source areas (as reviewed in the HRR), and an assumed northerly groundwater flow direction. Well names were assigned based on the five digit numbering system adopted by ER in 1992. The rationale for each new monitoring well location is summarized in Table 4-2.

Table 4- 2 Building 771 Monitoring Well Location Rationale

Well Number	Location	Rationale
40599	NW corner Building 771	Monitor downgradient groundwater quality
40699	North side Building 771, 70 feet West of NE corner	Monitor downgradient groundwater quality
40799	North side Building 771C, center of building	Monitor downgradient groundwater quality Building 771C, specifically process lines leak
40899	South side, south wing Building 774	Monitor upgradient groundwater quality, specifically six process waste tanks
P219089	Existing well; 80 feet west of NE corner Building 774	Monitor groundwater quality downgradient of building 774, specifically six process waste tanks

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4.1.3 Building 886

Three (3) new monitoring well locations have been chosen to monitor groundwater quality associated with Building 886. One (1) well will be positioned centrally along the west side of the building to monitor upgradient groundwater quality, and two (2) wells will be positioned to monitor downgradient groundwater quality. One downgradient well will be located at the southeast corner of the building and the other downgradient well will be located centrally along the east side of the building. In addition, existing well 22996 will be utilized to monitor downgradient water quality and existing well P317989 will be utilized to monitor water quality upgradient of building 875. Figure 1-3 illustrates the location of these wells with relationship to Building 886 and surrounding features. Individual well locations were determined with respect to potential contaminant source areas and an assumed northeast groundwater flow direction. Well names were assigned based on the five digit numbering system adopted by ER in 1992. The rationale for each new monitoring well location is summarized in Table 4-3.

Table 4- 3 Building 886 Monitoring Well Location Rationale

Well Number	Location	Rationale
40999	West side Building 886	Monitor upgradient groundwater quality
41099	North side Building 886	Monitor downgradient groundwater quality
41199	East side Building 886, 45 feet north of SE corner	Monitor groundwater quality downgradient of Buildings 886 and 875
22996	Existing well; 100 feet east of NE corner of Building 886	Monitor downgradient groundwater quality
P317989	Existing well; 180 feet SW of Building 886	Monitor groundwater quality upgradient of Buildings 875 and 886

4.2 Well Design and Installation

4.2.1 Well Design

The type of monitoring wells selected for installation at Buildings 444, 771, and 886 are small diameter

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well points that are suitable for monitoring shallow (generally less than 20-foot depth) alluvial and colluvial groundwater. These well points will have screens set through the alluvial saturated zone to detect for lateral migration of contaminants at depth. In some cases, where there is a thin saturated thickness, where groundwater is in the upper portion of the bedrock (weathered zone), or where dense non-aqueous phase liquids (DNAPLs) are a concern, wells may be drilled deeper. This may be important in the case of a newly flooded building basement. The screened interval will be selected for all wells to account for seasonal fluctuations in water table depth. Final depth determinations will be made in the field based on actual drilling conditions and initial depth to water.

At the Building 444 cluster, the alluvial thickness is approximately 22 feet with a saturated thickness ranging from 5 feet (well P419689) to 16 feet (well P218289). It is estimated that new monitoring wells in the Building 444 area will be approximately 25 feet deep, and the screened intervals will range from 10 to 20 feet.

At Building 771-771C-774, the colluvial thickness varies from 11 feet (well P219189) to 18 feet (well 22696) with a saturated thickness of less than one foot. Because of its unique location with respect to bedrock elevation, it is estimated that new monitoring wells in the Building 771 area will be approximately 20 feet deep and the screened intervals will be 5 to 10 feet in length.

At the building 886 cluster, the alluvial thickness ranges from 6.4 feet (well P317989) to 9 feet (well 22996) with a saturated thickness of approximately 3 feet. It is estimated that new monitoring wells in the building 886 area will be 10 to 15 feet deep and the screened intervals will range from 5 to 10 feet.

New monitoring wells will be installed using conventional single casing construction methods described in RMRS/OPS-PRO.118, *Monitoring Well and Piezometer Installation*. A special surface casing configuration modified from RMRS/OPS-PRO.114, *Drilling and Sampling using Hollow-Stem Auger and Rotary Drilling and Rock Coring Techniques,* will be utilized to isolate potential radiologically contaminated surface soils from well completion zones. Four-inch inside diameter (ID) polyvinyl chloride (PVC) surface isolation casing will set to a depth of 2 feet prior to advancing the borehole to the total depth. Typical monitoring well construction materials will consist of 0.75-inch ID, schedule 40 or 80 polyvinyl chloride (PVC) riser and factory cut (0.010-inch slot width) well screen. Flush-

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mount protective casings will be required to avoid damage in heavily trafficked areas around all buildings and areas that may be subject to D&D traffic.

Although the small diameter of these wells precludes the installation of dedicated monitoring devices for low flow rate sampling purposes, the wells should provide for the collection of groundwater samples that are comparable in quality to larger-diameter RFETS monitoring wells sampled with a bailer. Low-flow rate sampling using non-dedicated equipment may be possible for certain analytes provided that well yields are sustainable. It is expected that these monitoring wells will have a serviceable life of approximately five years for D&D monitoring purposes only.

4.2.2 Pre-Drilling Activities

Before drilling activities begin, all locations will be cleared in accordance with RMRS/OPS-PRO.102, *Borehole Clearing*, and marked in accordance with GT.39, *Push Subsurface Soil Sampling*. A radiological survey will be conducted before site work begins in accordance with 5-21000-OPS-FO.16, *Field Radiological Measurements*. All necessary health and safety protocols will be followed in accordance with the Project Health and Safety Plan.

4.2.3 Borehole Drilling and Logging

Borings will be drilled using push-type techniques (Geoprobe) at all proposed well locations. Detailed drilling and sampling procedures using this methodology are provided in GT.39, *Push Subsurface Soil Sampling*. If probe refusal is encountered before reaching the target borehole depth, the boring will be abandoned using procedure OPS-PRO.117, *Plugging and Abandonment of Boreholes*, and an offset boring will be attempted within 3 feet of the original boring. If probe refusal occurs repeatedly, a truck-mounted hollow-stem auger drill may be required to complete the boring. Detailed drilling and sampling procedures using this drilling method can be found in OPS-PRO.114, *Drilling and Sampling using Hollow-Stem Auger and Rotary Drilling and Rock Coring Techniques*.

Soil cores will be recovered continuously in at least two-foot increments using a 2-inch diameter (or 2.125-inch diameter for the dual-wall system) by 24- to 48-inch long stainless steel- or lexon-lined core barrel. Cores will be monitored following recovery, for health and safety purposes, with a Flame Ionization Detector (FID) or a Photoionization Detector (PID), as appropriate, in accordance with Site Procedure 5-21000-OPS-FO.15, *Photoionization Detectors and Flame Ionization Detectors*. In addition, cores will be surveyed for radiological contamination using a Bicron FIDLER or equivalent instrument in accordance with FO.16, *Field Radiological Measurements*. The core samples will then be boxed and logged in accordance with OPS-PRO.101, *Logging Alluvial and Bedrock Material,* except that logging will be conducted more qualitatively than specified in OPS-PRO.101 (i.e., sieving, examination with a microscope, and plasticity testing will not be conducted). All core boxes will be labeled and transferred to an ER core storage area for archiving following project completion. In the event that coring proves to be impractical or unnecessary, such as for the first 6 feet from ground surface, the well borings may be advanced using a retrievable drive point to allow for more efficient well installation.

4.2.4 Well Installation

Groundwater monitoring wells will be installed in accordance with OPS-PRO.118, *Monitoring Wells and Piezometer Installation*. Monitoring wells will be land surveyed in accordance with OPS-PRO.123, *Land Surveying*, or RFETS global positioning system manuals (Ashtech, 1993).

4.3 Well Development

Monitoring wells will be developed prior to sampling using the procedures specified in OPS-PRO.106, *Well Development,* with the exception that repeated vigorous surging utilizing a bailer may be employed to expedite formation damage restoration and maximize well yields for groundwater sampling. This approach has the best chance for success in wells containing a sufficient water column for surging and a thin annular sand pack, such as Geoprobe well points. Under these conditions, the removal of fines associated with formation damage can be more effectively accomplished because a much greater amount of surging energy is transmitted through the sand pack to dislodge materials at the borehole wall interface compared to wells completed with thick annular sand packs. All water produced during well development will be handled as uncharacterized development water in accordance

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with OPS-PRO.128, *Handling of Purge and Development Water.*

4.4 Sample Designation

The site standard sample numbering system will be implemented in this project. Location codes have been assigned to individual wells as shown in Figures 1-1, 1-2, and 1-3, and as listed in Tables 4-1, 4-2, and 4-3 using the ER well numbering convention adopted in 1992. For each groundwater sample collected from a well, dual sample numbers will be assigned: 1) a standard RIN sample number (i.e., 98AXXXX.00X.00X) will be assigned to the project by the Analytical Services Division (ASD), and 2) an RMRS sample number (i.e. GW0XXXXTE) will be assigned for internal sample tracking. The block of sample numbers will be of sufficient size to include the entire number of possible samples (including QA samples) and location codes. For reporting purposes, the ASD and RMRS sample numbers will be cross-referenced with location codes.

4.5 Sample Collection

Prior to sample collection, the water level will be measured according to OPS-PRO.105, *Water Level Measurements in Wells and Piezometers*, to determine purge water requirements. During the initial sampling round, water level measurements will also be taken from the following existing wells to aid in potentiometric map construction for the interpretation of groundwater quality data:

<u>Building 444</u>

P416289	P416889	P313489
P416589	P419689	P414189
P416689	P314289	P218289
P416789	P320089	4486

In addition, one or more monitoring wells installed in 1998 as part of Building 123 D&D activities will be utilized for water levels.

Building 771

77492	22695	22796
1986	22495	23895
22696	P219189	29395
05397	P219089	24395
P209289	25295	

In addition, new downgradient IHSS 118.1 groundwater investigation wells installed in January and February, 1999, may be utilized for water levels upgradient of Building 771.

Building 886

6186	37791	P213689
22996	P317989	
37591	37691	
1087	01391	

Groundwater samples will be collected using the methods specified in OPS-PRO.108, *Measurement of Groundwater Field Parameters*, and OPS-PRO.113, *Groundwater Sampling,* as modified for small diameter well points. Sampling procedures will be further modified for wells that prove to be incapable of yielding a full sample suite over the sampling period currently specified in OPS-PRO.113, *Groundwater Sampling*. These wells will be revisited and sample collection will continue past the third day as long as the well recharges sufficiently to warrant repeated sampling visits. Low flow rate sampling methods will be implemented for metals and radiological isotopes if all wells prove to be capable of providing a sustainable yield of 100 ml/minute or greater with minimal drawdown; otherwise, sampling will be performed with a small diameter bailer. After an initial sampling round is completed for all new wells, sampling of selected wells will be conducted on a semi-annual basis in support of D&D monitoring, as specified by the IMP (to be modified if D&D schedules are accelerated).

If necessary, a Health and Safety Specialist (HSS) or Radiological Control Technician (RCT) will scan each sample with a Field Instrument for the Detection of Low Energy Radiation (FIDLER). Equipment will also be monitored for radiological contamination during and after sampling activities. All sampling equipment will be decontaminated with a Liquinox solution, and rinsed with deionized or distilled water, in accordance with OPS-PRO.127, *Field Decontamination Operations*. Other sampling equipment will include standard items such as chain of custody seals and forms, field forms, etc.

Health and safety requirements will be specified in the Project Health and Safety Plan. Personal protective equipment (PPE), air monitoring requirements, and hazard assessments will be addressed in the Project Health and Safety Plan.

4.6 Sample Handling and Analysis

Samples will be handled according to RMRS/OPS-PRO.069, *Containing, Preserving, Handling, and Shipping of Soil and Water Samples,* and 4-K55-ENV-OPS-FO.10, *Receiving, Marking, and Labeling Environmental Materials Containers.*

Table 4-4 indicates the analytical requirements for each analyte. Samples will be submitted to an offsite, EPA-approved laboratory for analysis under a 30-day result turnaround time.

Table 4-4 Analytical Requirements for Groundwater Samples

Analysis	Building	Matrix	EPA Method	Container	Preservation	Holding Time
Target Analyte List (TAL) Metals	444, 771, 886	Water	EPA CLP plus additional metals	1 (one) 1-liter poly bottle	Field filtered (0.45 μm membrane), Cool to 4° C, HNO_3 to pH < 2	180 Days
Target Compound List (TCL) Volatiles	444, 771, 886	Water	EPA 524.2	3 (three) 40 ml amber glass (AG) vials with teflon-lids	Unfiltered, Cool to 4° C	14 days
Nitrates	444, 771, 886	Water	EPA 300 Methods	1 (one) 250 ml poly bottle	Cool to 4° C, H_2SO_4 to pH < 2	28 days
Cyanide	444	Water	EPA 9010	1 (one) 1-liter poly bottle	Unfiltered, NaOH to pH > 12, Cool to 4° C	14 days
Uranium Isotopes (U233/ 244,	444, 771, 886	Water	N/A[a]	1 (one) 1-liter poly bottle	Field filtered (0.45 μm membrane),	180 days

Analysis	Building	Matrix	EPA Method	Container	Preservation	Holding Time
U235, and U-238)					HNO_3 to pH<2	
Am-241, Pu-239/240	771, 886	Water	N/A[a]	1 (one) 1-gallon poly bottle	Unfiltered, HNO_3 to pH<2	180 days
Np-237	771	Water	N/A[a]	1 (one) 1-liter poly bottle	Unfiltered, HNO_3 to pH<2	180 days
Tritium	444, 771	Water	N/A[a]	1 (one) 125 ml glass bottle	None	None
Rad Screen	444, 771, 886	Water	N/A[a]	1 (one) 125 ml poly bottle	Unfiltered	180 days
TPH (TVPH + TEPH)	444	Water	EPA 8015 Modified	TVPH-3, 40ml VOA; TEPH-2, 500ml AG	HCl to pH<2, Cool to 4° C	14 days
PCBs	444, 771	Water	EPA 8081	1 (one) 1-liter AG	Cool to 4° C	7 days

[a] No EPA-approved method is currently in place for radionuclide analyses. However, guidance is provided in procedures defined in Environmental Monitoring Support Laboratory (EMSL)-LV 0539-17, *Radiological and Chemical Analytical Procedures for Analysis of Environmental Samples*, March 1979.

The list of analytes in Table 4-4 may be modified on a yearly basis as is provided for in the IMP. In addition to the above listed analytes, at Building 444 initial groundwater samples will be collected and analyzed for Total Petroleum Hydrocarbons (TPH) and polychlorinated biphenyls (PCBs); at Building 771 an initial groundwater sample will be collected and analyzed for PCBs. Because of historical practices at the buildings, there is some potential for these analytes in groundwater. If there are no detections for these analytes from the respective buildings, then they will be removed from the sampling program.

4.7 Equipment Decontamination and Waste Handling

Reusable sampling equipment will be decontaminated in accordance with procedure OPS-PRO.127, *Field Decontamination Operations*. Decontamination waters generated during the project will be managed according to procedure OPS-PRO.112, *Handling of Field Decontamination Water and Field Wash Water*. Geoprobe equipment will be decontaminated following project completion using procedure OPS-PRO.070, *Decontamination of Heavy Equipment at Decontamination Facilities*. Personal protective equipment will be disposed of according to 5-21000-OPS-FO.06, *Handling of Personal Protective Equipment*.

5.0 DATA MANAGEMENT

A project field logbook will be created and maintained by the project manager or designee in accordance with Site Procedure 2-S47-ER-ADM-05.15, *Use of Field Logbooks and Forms*. The logbook will include the time and date of all field activities, sketch maps of sample locations, and any additional pertinent information not specifically required by the SAP. The originator will legibly sign and date each completed original hard copy of data. Appropriate field data forms will also be utilized when required by the operating procedures that govern the field activity. A peer reviewer will examine each completed original hard copy of data. Any modifications will be indicated in ink, and initialed and dated by the reviewer. Logbooks will be controlled through RMRS Document Control.

Analytical data record storage for this project will be performed by KH-ASD. Sample analytical results will be delivered directly from the laboratory to KH-ASD in an Electronic Disc Deliverable (EDD) format and archived in the Soil and Water Database (SWD) as per RMRS/OPS-PRO.072, *Field Data Management*. Hard copy records of laboratory results will be obtained from KH-ASD in the event that the analytical data is unavailable in EDD or SWD at the time of report preparation. Groundwater analytical results will be compiled into a sampling and analysis report.

6.0 PROJECT ORGANIZATION

Figure 6-1 illustrates the project organization structure. The RMRS ER Groundwater Operations Project Manager (PM) will be responsible for maintaining data collection and management methods that are consistent with Site operations. The PM is the individual responsible for overall project execution from pre-conceptual scoping through project implementation and closeout. Other individuals assisting with the implementation of this project are the RMRS Health and Safety Supervisor who is responsible for overall compliance with and implementation of the Project Health and Safety Plan. The RMRS

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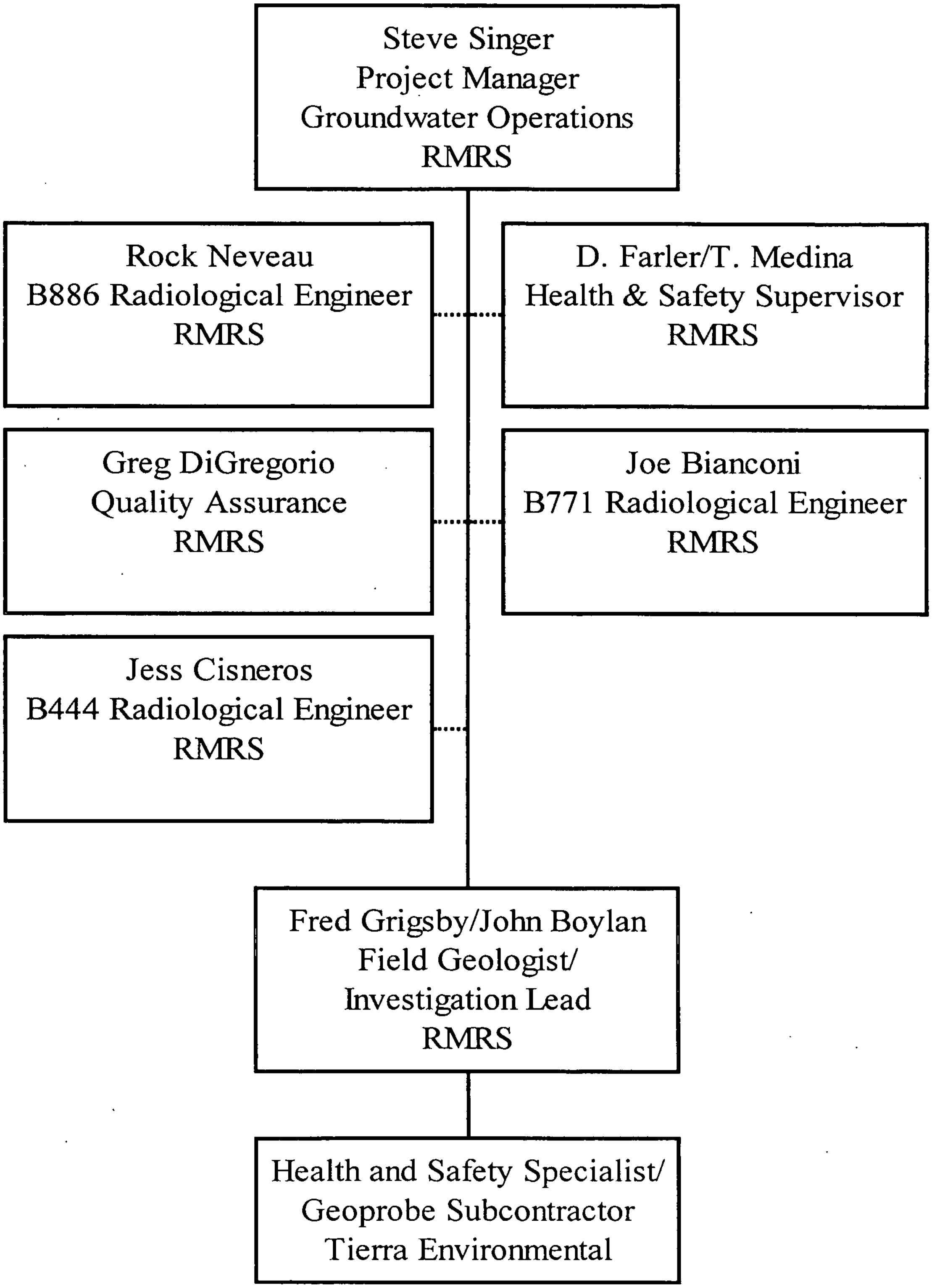
Figure 6- 1 Buildings 444, 771, and 886 D&D Groundwater Monitoring Organization Chart



Quality Assurance engineer will provide the first level of oversight and support implementation of quality controls within all quality-affecting activities of the project. The RMRS Radiological Engineer is responsible for overseeing the development and implementation of and ensuring compliance with the radiological aspects of the Project Health and Safety Plan, ALARA Job Review, and approval of applicable RWPs.

The Field Geologist/Investigation Lead will be responsible for field data collection, documentation, directing drilling, and well installation. They will oversee the Health and Safety Specialist who will be responsible for onsite compliance with and implementation of the Project Specific Health and Safety Plan. In addition, they will also oversee sampling personnel responsible for field data collection, sample collection, and transfer of samples for analysis. Field data collections will include sampling and obtaining screening results. Documentation will require field logs and completing appropriate forms for data management and chain-of-custody shipment. The sampling crew will coordinate sample shipment for on-site and off-site analyses through the ASD personnel. The sampling personnel are responsible for verifying that chain-of-custody documents are complete and accurate before the samples are shipped to the analytical laboratories..

7.0 QUALITY ASSURANCE

All components and processes within this project will comply with the RMRS Qualify Assurance Program Description RMRS-QAPD-001, Revision 2 (RMRS, 1998a), which is consistent with the K-H Team QA Program. The RMRS QA Program is consistent with quality requirements and guidelines mandated by the EPA, CDPHE, and DOE. In general, the applicable categories of quality control are as follows:

- Quality Program;
- Training;
- Quality Improvement;
- Documents/Records;
- Work Processes;
- Design;
- Procurement;

- Inspection/Acceptance Testing;
- Management Assessments; and
- Independent Assessments.

The project manager will be in direct contact with QA to identify and correct issues with potential quality affecting issues. Field sampling quality control will be conducted to ensure that data generated from all samples collected in the field for laboratory analysis represents the actual conditions in the field. The confidence levels of the data will be maintained by the collection of QC samples, consisting of duplicate samples and equipment rinsate samples.

Duplicate samples will be collected on a frequency of one duplicate sample for every twenty real samples. Rinsate samples will be generated at a frequency of one rinsate sample for every 20 real samples collected. Data validation will be performed on 25% of the laboratory data according to the Rocky Flats ASD, Performance Assurance Group procedures. Samples will be randomly selected from adequate subsurface sample sets (RINS) by ASD personnel to fulfill data validation of 25% of the total number of VOC and radioisotope analyses. Table 7-1 provides the QA/QC samples and frequency requirements of QA sample generation.

Table 7- 1 QA/QC Sample Type, Frequency, and Quantity

Sample Type	Frequency	Comments	Estimated Quantity
Duplicate	One duplicate for each twenty real samples		1
Rinse Blank	One rinse blank for each twenty real samples	To be performed with reusable sampling equipment following decontamination procedures	1

Analytical data that is collected in support of this SAP will be evaluated using the guidance developed by the Rocky Flats Administrative Procedure 2-G32-ER-ADM-08.02, *Evaluation of ERM Data for Usability in Final Reports*. This procedure establishes the guidelines for evaluating analytical data with respect to precision, accuracy, representativeness, completeness, and comparability (PARCC) parameters.

A definition of PARCC parameters and the specific applications to the investigation are as follows:

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Precision. A quantitative measure of data quality that refers to the reproducibility or degree of agreement among replicate or duplicate measurements of a parameter. The closer the numerical values of the measurements are to each other, the lower the relative percent difference and the greater the precision. The relative percent difference (RPD) for results of duplicate and replicate samples will be tabulated according to matrix and analytical suites to compare for compliance with established precision DQOs. Specifications on repeatability are provided in Table 7-2. Deficiencies will be noted and qualified, if required.

Accuracy. A quantitative measure of data quality that refers to the degree of difference between measured or calculated values and the true value of a parameter. The closer the measurement to the true value, the more accurate the measurement. The actual analytical method and detection limits will be compared with the required analytical method and detection limits for VOCs and radionuclides to assess the DQO compliance for accuracy.

Representativeness. A qualitative characteristic of data quality defined by the degree to which the data absolutely and exactly represents the characteristics of a population. Representativeness is accomplished by obtaining an adequate number of samples from appropriate spatial locations within the medium of interest. The actual sample types and quantities will be compared with those stated in the SAP or other related documents and organized by media type and analytical suite. Deviation from the required and actual parameters will be justified.

Completeness. A quantitative measure of data quality expressed as the percentage of valid or acceptable data obtained from a measurement system. A completeness goal of 90% has been set for this SAP. Real samples and QC samples will be reviewed for the data usability and achievement of internal DQO usability goals. If sample data cannot be used, the non-compliance will be justified, as required.

Comparability. A qualitative measure defined by the confidence with which one data set can be compared to another. Comparability will be attained through consistent use of industry standards (e.g., SW-846) and standard operating procedures, both in the field and in laboratories. Statistical tests may be used for quantitative comparison between sample sets (populations). Deficiencies will be qualified, as required. Quantitative values for PARCC parameters for the project are provide in Table 7-2.

Laboratory validation shall be performed on 25% of the characterization data collected in support of this project. Laboratory verification shall be performed on the remaining 75% of the data. Data usability shall be performed on laboratory validated data according to procedure RF/RMRS-98-200, *Evaluation of Data for Usability in Final Reports*.

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Table 7- 2 PARCC Parameter Summary

PARCC	Radionuclides	Non-Radionuclides
Precision	Duplicate Error Ratio ≤ 1.42	RPD ≤ 30% for Organics RPD ≤ 30% for Non-Organics
Accuracy	Detection Limits per method and ASD Laboratory SOW	Comparison of Laboratory Control Sample Results with Real Sample Results
Representativeness	Based on SOPs ,SAP, and analytical methods	Based on SOPs, SAP, and analytical methods
Comparability	Based on SOPs and SAP	Based on SOPs and SAP
Completeness	90% Useable	90% Useable

Data validation will be performed according to KH-ASD procedures, but will be done after the data is used for its intended purpose. Analytical laboratories supporting this task have all passed regular laboratory audits by KH-ASD.

8.0 SCHEDULE

Well installation activities are scheduled to begin in mid to late May, 1999. Well development and groundwater sampling will commence within one week of well completions. Measurement of water levels from existing monitoring wells for potentiometric map construction will be conducted within one week of groundwater sampling.

9.0 REFERENCES

Ashtech 1993, *Ashtech XII GPS Receiver Operating Manual,* Version 7.

DOE 1992a, *Historical Release Report for the Rocky Flats Plant,* Rocky Flats Plant, Golden, CO.

DOE 1992b, *Final Phase I RFI/RI Work Plan for Operable Unit 9, Original Process Waste Lines.*

DOE 1993, *Background Geochemical Characterization Report,* September.

DOE 1994, *Final Interim Measures/Interim Remedial Action Decision Document for the Rocky Flats Industrial Area,* Rocky Flats Plant, Golden, Colorado, March.

DOE 1998, *Rocky Flats Environmental Technology Site, Integrated Monitoring Plan, FY98/99,* August.

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EG&G, 1995a, *Geologic Characterization Report for the Rocky Flats Environmental Technology Site, Volume 1 of the Sitewide Geoscience Characterization Study,* Final Report, April.

EG&G, 1995b, *Hydrogeologic Characterization Report for the Rocky Flats Environmental Technology Site, Volume II of the Sitewide Geoscience Characterization Study,* Final Report, April.

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Hurr, R. T., 1976, *Hydrology of a Nuclear-Processing Plant Site, Rocky Flats, Jefferson County, Colorado*, U.S.G.S. Open-File Report 76-268.

RMRS 1998a *RMRS Quality Assurance Program Description,* RMRS-QAPD-001, Rev. 2, *April.*

RMRS, 1998b, *1997 Annual Rocky Flats Cleanup Agreement (RFCA) Groundwater Monitoring Report for Rocky Flats Environmental Technology Site,* RF/RMRS-98-273.UN, November

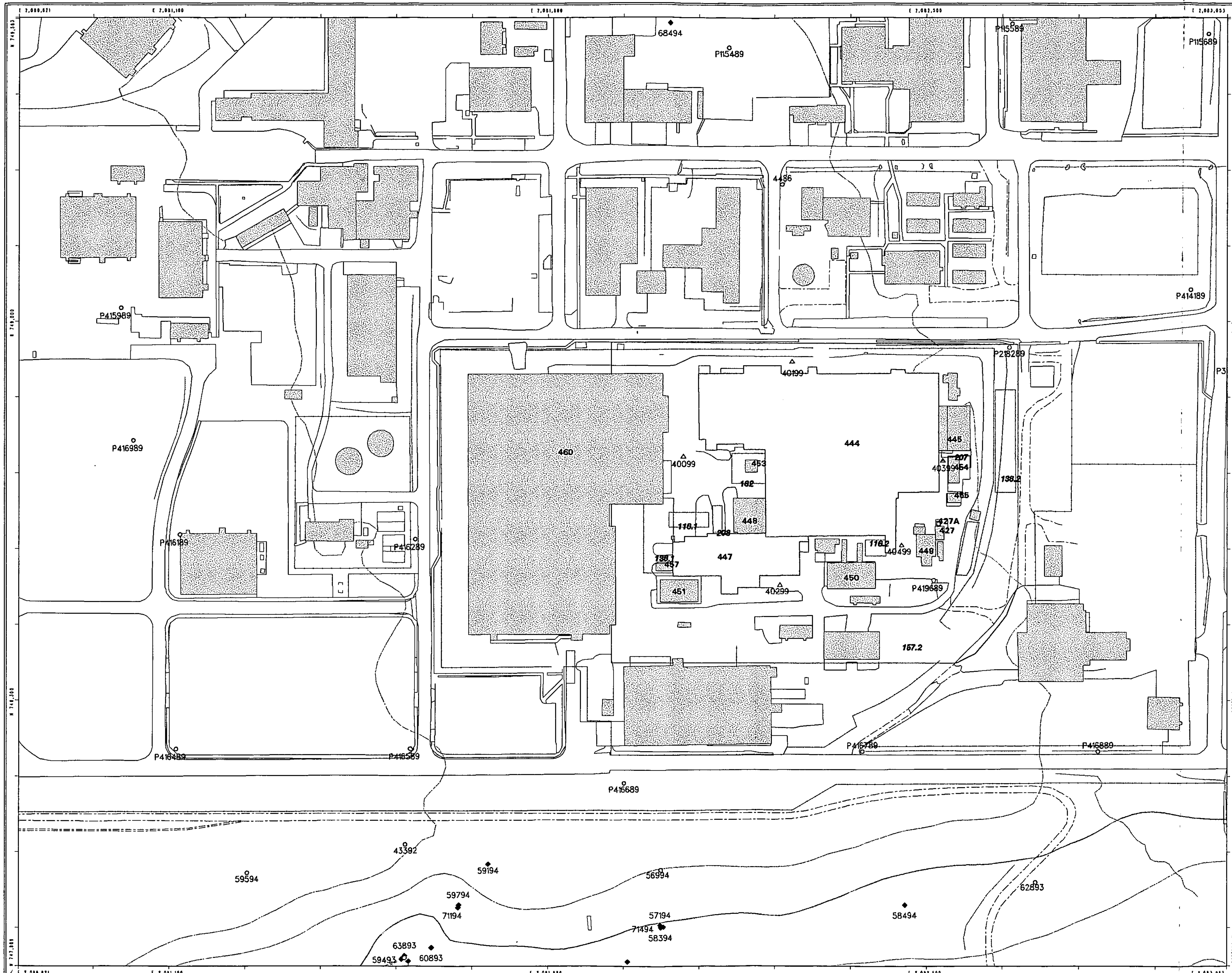

Figure 1-1

Building 444 Site Location
Existing and Proposed Monitoring Wells

EXPLANATION

- Program Wells
- All Other Wells (Abandoned Wells Not Included)
- Location of Proposed Monitoring Wells

Industrial Area Operable Units

- Pertinent B444 IHSSs

Standard Map Features

- Buildings and other structures
- Solar evaporation ponds
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Contour (20-Foot)
- Paved roads
- Dirt roads

DATA SOURCE:
Buildings, fences, hydrography, roads and other structures from 1994 aerial fly-over data captured by EG&G RSL, Las Vegas.
Digitized from the orthophotographs. 1/95
Topology (contours) were derived from digital elevation model (DEM) data by Morrison Knudsen (MK) using ESRI Arc TIN and LATTICE to process the DEM data to create 5-foot contours.
The DEM data was captured by the Remote Sensing Lab, Las Vegas, NV, 1994 Aerial Flyover at ~10 meter resolution.
DEM post-processing performed by MK, Winter 1997.

Scale = 1 : 2170
1 inch represents approximately 181 feet

50 0 100 200ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Prepared by:

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P.O. Box 464
Golden, CO 80402-0464

MAP ID: 99-0163

April 22, 1999

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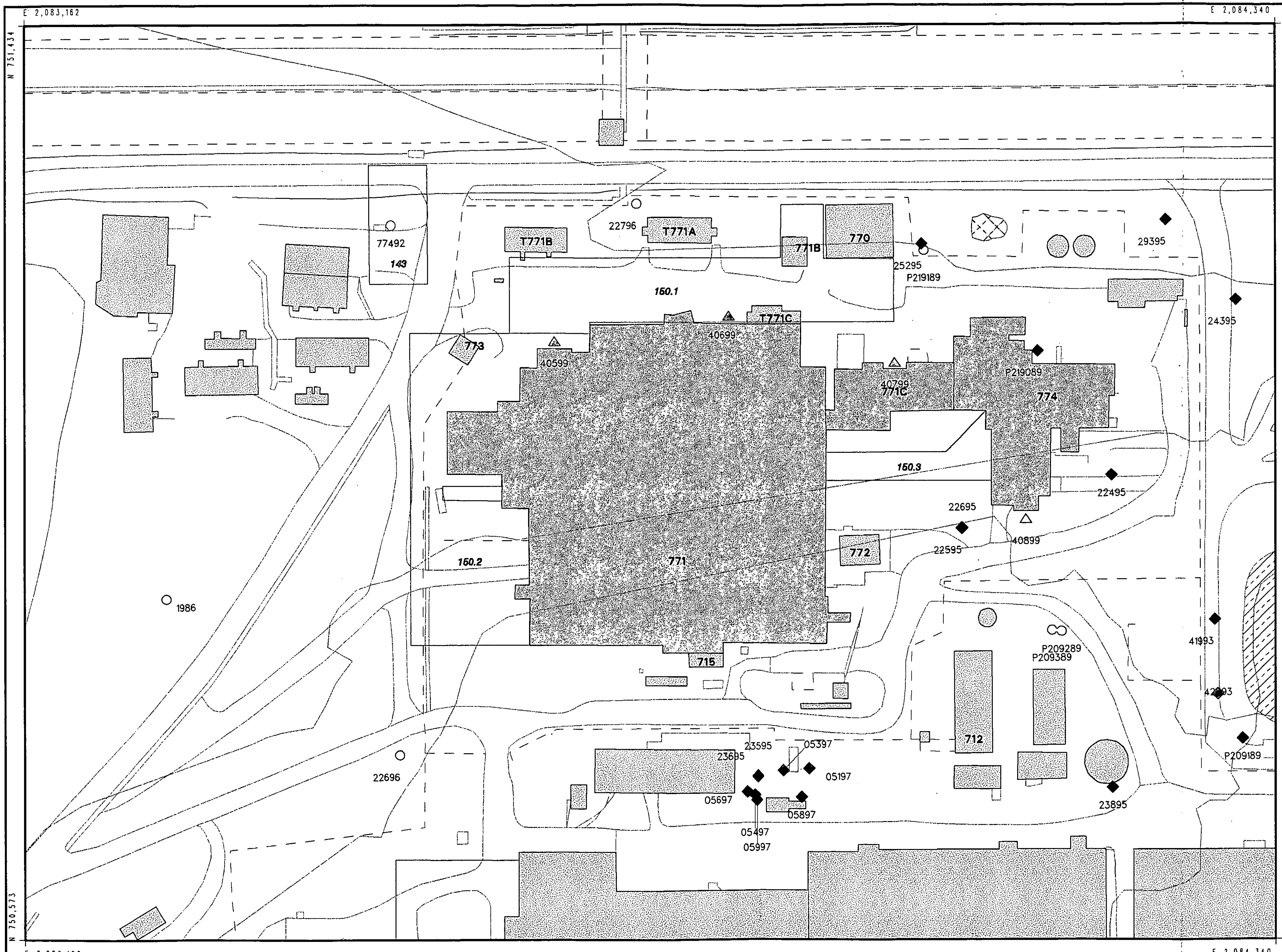
Figure 1-2

Building 771 Site Location

Existing and Proposed Monitoring Wells



EXPLANATION

- Program Wells
- All Other Wells (Abandoned Wells Not Included)
- Location of Proposed Monitoring Wells

Industrial Area Operable Units

- Pertinent B/771 IHSSs

Standard Map Features

- Buildings & other structures
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Contours (20' Intervals)
- Roads

DATA SOURCE:
Buildings, fences, hydrography, roads and other structures from 1994 aerial fly-over data captured by EG&G RSL, Las Vegas. Digitized from the orthophotographs. 1/95
Individual Hazardous Substance Sites (IHSS) DOE 1992, HRR Report and Subsequent Updates.

Scale = 1 : 1100
1 inch represents approximately 92 feet

45 0 90ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Prepared by:

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MAP ID: 99-0163-Map2 March 11, 1999

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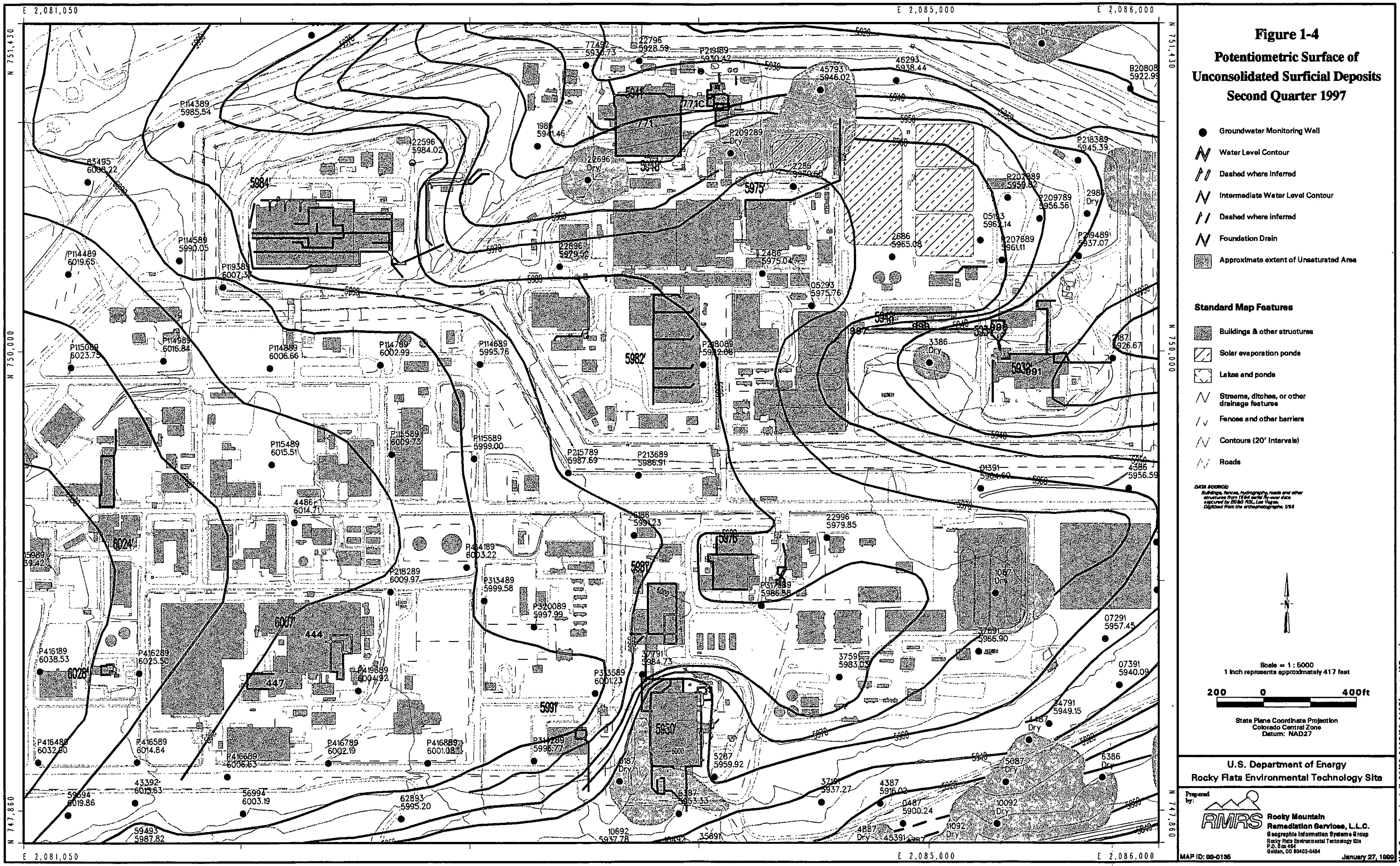
Figure 1-4
Potentiometric Surface of Unconsolidated Surficial Deposits Second Quarter 1997
Groundwater Monitoring Well
Water Level Contour
Dashed where Inferred
Intermediate Water Level Contour
Dashed where inferred
Foundation Drain
Approximate extent of Unsaturated Area
Standard Map Features
Buildings & other structures
Solar evaporation ponds
Lakes and ponds
Streams, ditches, or other drainage features
Fences and other barriers
Contours (20' Intervals)
Roads
Scale = 1 : 5000
1 inch represents approximately 417 feet
200 0 400ft
State Plane Coordinate Projection
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MAP ID: 98-0136
January 27, 1999
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N 751,430
N 750,000
N 747,860

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